Organizational transformation in the public sector

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Abstract

We build a model of endogenous organizational transformation in the public sector. The two key players – regulatory authorities and monopoly service provider – can be voluntary engaged in the strategic partnership which may be further privatized. The corporate structure of the established joint venture reflects the sharing rule for both risks and rewards and can be motivated by the exit strategy of the public agent. In particular, an option to generate revenues from privatization of the government's stake in the partnership provides the regulator with incentives to increase commercial attractiveness of the enterprise. However, being a benevolent social welfare maximizer the regulator faces a certain trade-off: the higher its involvement in the partnership and relatively greater concern about consumer surplus the lower profitability and expected gains from privatization. The optimal structure of the partnership emerges endogenously at the first stage of a bargaining regulatory game. At the second stage the government takes into account the availability and cost of public funds and may execute an option to sell its stake in the partnership. These strategic considerations of future privatization may shed some light on the diversity of organizational forms in the public sector.

Keywords: Public-private partnership; Privatization; Organizational choice; Delegation; Railway reform; Suburban transport

JEL classification: H72; L33; L51; L92;

1 INTRODUCTION

The ownership structure of suburban railway undertakings in Russia has been evolving from publicly operated services to the establishment of Suburban Passenger Companies (SPCs) in the form of joint ventures between local authorities and regional divisions of the vertically integrated monopoly (Russian Railways - RZD). Such a development in organizational capacity in the form of trusting partnership has been viewed as an improvement with regard to vaguely determined and weakly enforced Public Service Obligation (PSO) contracts. These two delivery models vary across 73 Russian regions in terms of the ownership structure of SPCs as well as the share of operators' losses that are de facto compensated from the local budget each year.

Recent experience in the sector has revealed a tendency for polarization at the strategic level of transport planning. While the private ownership has increased in the railway undertakings operating the most lucrative transportation markets (Moscow City and Moscow Region), the lack of trust and budget constraints have led to complete abandonment of railway commuters in economically depressed regions.

We explain this diversity of organizational forms in the sector by the variance in budget constraints across Russian regions and build a model of a strategic partnership between the public authorities and regulated service provider. This is a dynamic version of the theoretical framework developed in (Dementiev & Loboyko, 2014). The corporate structure of the established joint venture reflects the sharing rule for both risks and rewards, but in the proposed model it can be motivated also by the exit strategy of the public agent. In particular, an option to generate budget revenues from privatization of the government's stake in the partnership provides the regulator with the incentives to increase commercial attractiveness of the joint enterprise. The *ex ante* optimal structure of the partnership emerges endogenously at the first stage of a bargaining regulatory game. At the second stage the government takes into account the availability and cost of public funds and may execute an option to sell its stake in the partnership.

In case of privatization the regulator may enhance the value of its stake in the partnership by setting higher tariffs for passengers and/or securing higher transfer payments to the service provider. If the expected value is positive the government's stake can be privatized. The revenues from privatization partially relax the budget constraint at least in the short run. Alternatively, the government may initiate the complete abandonment of the rail services and switch to an alternative transportation mode (buses). This could turn out to be socially optimal if commuters' demand for transportation by rail is relatively small and highly elastic, for instance, due to higher tariffs. These considerations of possible future 'exit' from the partnership may shed some light on the diversity of organizational forms in the suburban railway sector in Russia. The theoretical insights of the paper can be further generalized to the cases with limited public sector institutional capacity.

We contribute to the literature on bargaining games between an uninformed principal and an informed agent in the environment when the decision rights are contractible and can be traded between parties (Lim, 2012).We modify this approach in a few important directions. First, we consider a two-stage game where Local Authorities (LA) make the decision to accept or reject the offer to form private-public partnership (PPP) with the service provider at the first stage and then execute the option to sell their share in PPP at the second stage when information about government fiscal stance is revealed.

The paper is structured as follows. Section 2 develops the two-stage bargaining game with delegation and considers four cases: 1) PSO contract, 2) cross-subsidization, 3) delegation of contracting to public-private partnership, and 4) partial privatization. Section 3 discusses the bargaining outcomes and Section 4 concludes.

3. THE MODEL

The game is structured as follows: the public sector reform is viewed as a change of delivery model from the traditional regulatory contract (PSO) to PPP. The establishment of PPP with the corporate structure $(\omega;1-\omega)$ can be initiated by the monopoly services provider (the Firm) in the form of tioli offer to local authorities (LA), where $0 \le \omega \le 1$ is LA's share in PPP. LA performs like a benevolent social welfare maximiser and decidea whether to get engaged in PPP or not having in mind an option to sell at a later stage its share in PPP. The model setup for the privatization stage is inspired by (Laffont & Tirole, 1993) and (Vickers & Yarrow, 1997) specifically we assume that LA does not know the true cost level of the Firm.

We denote consumer utility from output level as $V(Q)$, where the inverse demand curve is written as $P(Q) = V'(Q)$. We also introduce the revenue of the firm denoted as $R(Q) = P(Q)Q$, and T standing for the transfer paid to the firm, which can also take negative values. The net consumer surplus is denoted as $S(\theta) = V[Q(\theta)] - R[Q(\theta)] - T(\theta)$ and profit $\pi(\theta) = P(Q)Q - \theta Q + T(\theta) + F = R(Q) - \theta Q + T(\theta) + F$, where F stands for fixed costs.

By the nature of the variables that we have introduced the objective function of the regulator can be viewed as a function of expectations of uncertain unit product cost of providing the service, θ Due to the presence of the concern for distribution, the regulator places lower weight α for profit relative to consumer surplus in the social welfare representation:

$W(\theta) = S[Q(\theta)] + \alpha\pi(\theta) = V[Q(\theta)] - R[Q(\theta)] - (1+\lambda)T(\theta) + \alpha\pi(\theta)$, where the shadow cost of public funds, $\lambda \ge 0$, which stems from distortionary nature of taxation.

There are four scenarios, which we aspire to consider. If the Local Authorities estimate they have enough funds to run suburban railway services on their own, without engaging in PPP structure, following Vickers and Yarrow (1997) we propose that the regulator's optimization problem is confined to the following[1]: the firm is required to report its' cost level $\hat{\theta}$, the level of output $Q(\hat{\theta})$ and the corresponding transfer $T(\hat{\theta})$ are determined accordingly. Provided the quantity of the service provision and the optimal transfer are defined based on the reported unit cost of production, there is no incentive for the firm to report its' cost level untruthfully.

3.1 PUBLIC SERVICE OBLIGATION

While modelling this situation we assume that the transfer consists of two components: one being fixed, and the other varying with the level of costs incurred. By introducing such type of two-part tariff we allow the regulated Firm to be compensated for additional costs it incurs. We might also be interested in the tariff structure being $T[Q(\hat{\theta})]$, where the level of compensation would vary with the level of the service provided, so that this would serve as a sort of subsidy to the service provider. This could arise if we wanted to distinguish between the effects of an increase in the patronage and rise in the cost of the service, which may be of special importance if, for instance, we were to deal with fare-dodgers. We would provide some treatment of this case as an extension to the existing model. For the time being, we are interested in the family of functions described by the following equation:

$$T(\theta) = \overline{T} + t\theta$$

[1] This is valid providing that the revelation principle holds. For the formal proof and theoretical treatment of this refer to Alonso and Matouschek (2008), Myerson (1979) and Dasgupta et al. (1979)

Since the standard assumption employed draws on positive dependence of the compensation required on the cost level, we assume $t \geq 0$ In the specific case when $t = 0$, we are faced with the transfer being exogenously determined independent of the level of costs.

To be capable of figuring out an explicit form for the expression for the tariff and transfer, we would assume for simplicity that demand function is linear:

$$Q(P) = a - bP$$

So, we are now in a position to consider the benevolent social welfare maximizer who chooses $Q(\theta)$ and $T\left[Q(\hat{\theta})\right]$ to maximize the expected social welfare function subject to incentive compatibility constraint (IC), ensuring that the firm prefers the $\{P(\theta), T(\theta)\}$ pair to any other given the private information θ, and individual rationality constraint (IR), guaranteeing that the firm makes nonnegative profit from the chosen price-transfer pair.

So, denote $\pi(\hat{\theta}, \theta) = R\left[Q(\hat{\theta})\right] - \theta Q(\hat{\theta}) + T\left[Q(\hat{\theta})\right] - F$ being the profit in state θ when $\hat{\theta}$ is reported. Define $\pi(\theta) = \pi(\theta, \theta)$ consistent with Vickers and Yarrow (1997). It follows that the regulator's maximization problem can be written as:

$$\begin{cases} EW = \int_{\underline{\theta}}^{\overline{\theta}} \left[S(\theta) + \alpha\pi(\theta)\right] d\theta \xrightarrow{Q \geq 0} \max \\ *(IC) \rightarrow s.t. \pi(\theta) \geq \pi(\hat{\theta}, \theta) \forall \hat{\theta}, \theta \\ **(IR) \rightarrow s.t. \pi(\theta) \geq 0 \forall \theta \end{cases}$$

Note, that IR is binding only at $\overline{\theta}$ [2], since for $\theta < \overline{\theta}$, we get:

$$\pi(\theta) \geq \pi(\overline{\theta}, \theta) > \pi(\overline{\theta})$$

It can be demonstrated that in the absence of the shadow cost of public funds, $\lambda = 0$ the results are identical to those obtained by Vickers and Yarrow (1997) (see the Appendix for the proof):

$$P\left[Q(\theta)\right] = \theta + (1 - \alpha)(\theta - \underline{\theta}) \qquad \text{(A1)}$$

$$\frac{\partial P}{\partial \alpha} = \underline{\theta} - \theta < 0$$

Now we can compute the optimal amount of the service provided and the level of transfer required to ensure that the firm with the highest cost level (an inefficient firm) is compensated enough to break-even in the long-run:

[2] Vickers and Yarrow (1997) note that "the rent accruing to the firm from its monopoly of information derives from this fact". The binding restriction on profit for the most inefficient firm is also given an intuitive explanation in Armstrong and Sappington (2006).

$$Q^{OPT} = a - b\frac{1}{1+2\lambda}\left[(\lambda+1-\alpha)(\theta-\underline{\theta})+\theta(1+\lambda)+\frac{a}{b}\lambda\right]$$

$$T(\overline{\theta}) = F + Q^{OPT}(\theta - P^{OPT}) =$$

$$= F + \left[a - b\frac{1}{1+2\lambda}\left[(\lambda+1-\alpha)(\overline{\theta}-\underline{\theta})+\overline{\theta}(1+\lambda)+\frac{a}{b}\lambda\right]\right]*$$

$$*\left[\overline{\theta} - \frac{1}{1+2\lambda}\left[(\lambda+1-\alpha)(\overline{\theta}-\underline{\theta})+\overline{\theta}(1+\lambda)+\frac{a}{b}\lambda\right]\right]$$

So that $T(\overline{\theta})$ is sufficient for the Local Authorities to agree to engage in PSO with the level of transfer being $T^{PSO}(\theta) < T(\overline{\theta})$ for more efficient firms, although everyone would opt for the highest transfer.

Obviously, this allows us to expect that higher relative weight of the service provider is associated with higher level of compensation from the Regulator, opening the possibility for tariff reduction on the side of the Firm.

Proposition 1: in asymmetric information framework, optimal tariff is a decreasing function and sufficient transfer is an increasing function of relative weight, α, imposed on producer in the social welfare function.

This result is opposite to the one obtained under complete information framework and the transfer being exogenously determined.[3] Intuitively, this implies that the higher the Regulator values the share of the service provider in social welfare function, the higher benefits the latter will receive in the form of financial support, since the level of the support now accounts for the amount of the costs incurred and not merely determined outside of the model. However, such state of affairs may benefit the consumers as well in a sense that the higher is the portion of costs covered by external means – the lower the tariff that the Firm sets.

The expressions for profit and expected social welfare as well as the change in the two with respect to the change in the weight α are examined in the Appendix. It follows that inferences for profit reveal ambiguous effect which arises due to the trade-off between higher transfer payment and reduced tariff which are a result of the increased weight ascribed to producers. Whereas the resulting expected social welfare increases with the rise in α, $\frac{\partial EW^{PSO}}{\partial \alpha} > 0$ (see the Appendix for the proof). This counterintuitive result may be explained by the fact that higher weight placed on producers leads to greater compensation in the form of tariff required, which opens the field for tariff reduction and increase in patronage. These positive effects outweigh the downward pressure of higher transfer on social welfare; hence, the resulting influence is positive. However, it should also be noticed that the higher is the shadow cost of public funds – the stronger is the downward pressure of the transfer increase.

We should now emphasize what distinguishes the choice between PSO and cross-subsidization. As we have already outlined, the first stage of the Reform has created expectations of the tariff being determined in accordance with the expected cost level. Together with the expectations formed the budget constraint which is limiting becomes revealed. As we have already shown, the higher weight of the service provider is associated with the higher level of transfer, which positively depends on the amount of the service provided. It follows that the agents get signal whether the compensation is sufficient to guarantee that the most inefficient firm breaks-even. If

[3] For analytical derivation and intuition of this case see Dementiev and Loboyko (2014)

this is not the case, the Local Authorities do not engage in PSO and the burden is levied on the service provider which acts as a profit maximizer.

3.2 CROSS-SUBSIDIZATION

Let's now demonstrate the setup that occurs when the government budget is revealed to be insufficient to ensure the firm breaks even in the long-run. Namely, at this stage the capabilities of the governmental budget constraint become known. If, given this informational signal, the transfer happens to be less than necessary to ensure the most inefficient firm breaks-even in the long-run[4], we are faced with following problem:

$$\begin{cases} EW = \int_{\underline{\theta}}^{\bar{\theta}} \left[S(\theta) + \alpha\pi(\theta) \right] d\theta \xrightarrow{Q\geq 0} \max \\ *(IC) \to s.t. T^{CAP} = \pi + Q(\theta - P) + F < T(\bar{\theta}) \\ **(IR) \to s.t. \pi(\theta) \geq 0 \forall \theta \end{cases}$$

The intuition behind this setup is as follows: under the limiting budget the financial support from the government happens to be insufficient to fully cover the needs of the most inefficient firms. As a result, either all firms leave which is followed by the closure of the line of business, or the most efficient firms stay and earn positive economic profit as soon as their individual rationality constraint is not binding. In the latter case, however, the size of the market reduces significantly since we are dealing with the specific industry, which cannot be sustainably operating if the sufficient portion of its' costs are not fully covered by the government.[5]

Proposition 2: if the transfer level is lower than $T^{OPT}(\bar{\theta})$*, the government budget is insufficient to engage in PSO and the corresponding quantity of the service provided is zero.*

(See the Appendix for the proof.)

This line of reasoning is, naturally, consistent with the real-life situation as we observe nowadays – due to the lack of financial support from the Regional Authorities, the service provider with outrageously increasing frequency announces its' decisions of optimization and possibility of ultimate closure of the lines.

In other words, the operating decision that follows is closure of the line and switching to alternative means of transportation, such as buses. so, this outcome must be suboptimal for both society and the service provider. While the former bears losses associated with closure of the means of transportation that used to serve both economic and social functions, the latter except from suffering liquidation costs that might be associated with the closure drops an opportunity to extract additional profit which under asymmetric information framework may take positive values. Likewise, the scope for privatization as an additional policy instrument that, as will be shown further, acts as fiscal efficiency enhancer is not available under both PSO and cross-subsidization. In this context creation of PPP serves as a reference point for achieving the aim of reducing the distortionary effect of taxation and redistributing the extracted surplus to enhance social welfare.

3.3 DELEGATED CONTRACTING

One of the distinct features of delegated contracting stems from the fact that the Regulator being a benevolent social welfare maximizer delegates the decision-making process to PPP, which has

[4] Equivalently, if the transfer happens to be less than the one we have determined under PSO.

[5] This, in turn, stems from the fact that socially optimal tariff is set to be less than economically optimal one

$(\omega;1-\omega)$ structure, where ω belongs to the LA and the rest to the service provider. As has been outlined, "the objective function of this party is the weighted average of social welfare, that is, regulator's objective function, and monopoly's profit, that is, service provider's objective function". Hence, it can be modelled as:

$$U_{PPP} = \omega W + (1-\omega)\pi$$

Note that incentive and participation constraints hold for the delegated contracting as well, since bearing in mind the motivation for privatization as a long-term decision, the condition for the Firm to break-even would serve as a necessary one. Furthermore, we do not relax the asymmetric information framework, since the revelation of the parameters in neither period is implied by our model to better approach the real-life case. This assumption holds for the particular setup as well because the agenda of our paper is to treat PPP as an intermediary stage necessary for future social welfare improvement, rather than blessing in itself prompting elimination of informational asymmetry.

So far there has been some vaguely outlined field for social welfare improvement. However, we have not clearly stated yet by what means and how this enhancement could occur. As soon as we are continuing placing ourselves within the context of asymmetric information, there does not seem to evolve any benefit associated with elimination of informational distortions as a result of PPP creation. To get a better insight of where the advantage may come from, let's examine the objective function of the newly created enterprise

$$U_{PPP} = \omega W(P) + [1-\omega]\pi = \omega[V(P) - [1+\lambda]T + \alpha\pi] + [1-\omega]\pi = \omega V(P) - \omega[1+\lambda]T + [1-\omega[1-\alpha]]\pi =$$
$$\omega\left[V(P) - [1+\lambda]T + \frac{[1-\omega[1-\alpha]]}{\omega}\pi\right]$$

Following the lines of Dementiev and Loboyko (2014), we introduce a new variable standing for the weight of the producer surplus in the objective function of PPP, which is analogous to α in the objective function of the Regulator described above:

$$\psi = \frac{(1-\omega(1-\alpha))}{\omega} = \frac{1}{\omega} - (1-\alpha) = \alpha + \left(\frac{1}{\omega} - 1\right)$$

$$\psi = \alpha \; iff \; \omega = 1$$

$$\frac{\partial\psi}{\partial\omega} = -\frac{1}{\omega^2} < 0$$

This implies that when PPP is established the relative weight placed on producer surplus is higher compared to the benchmark case.

The first proposition that we have made holds for this setup as well. This implies that the higher the relative weight placed on producer surplus – the higher is the level of transfer needed to compensate the service provider to ensure that it at least breaks even in the long –run. What is more, despite the increase in the valuation of profit, there is still a field for extracting benefit on the side of consumers. Namely, the tariff reduction generates a positive influence.

Proposition 3: the transfer level $T^{PPP}(\bar{\theta}) = F + Q^{PPP}(\theta - P^{PPP})$*, where* (Q^{PPP}, P^{PPP}) *are defined above, is sufficient for the Local Authorities to accept the offer of the service provider to engage in PPP with* $(\omega;1-\omega)$ *structure.*

(See the Appendix for the proof.)

Note that while profit levels under PPP and PSO are not comparable, as has been outlined above, expected welfare under PPP is higher than that under PSO (see the Appendix for the proof.)

3.4 PRIVATIZATION

As we have already outlined, establishing PPP implies creation of the joint venture with the share structure specified as $(\omega;1-\omega)$, where ω represents the portion attributable to the LA. When defining the operational setup, we have assumed that while the service provider preserves its' portion of the ownership, LA are given an option to sell their share to private investors. However, we have noticed the importance of the social function levied on the operation of suburban railways. Meanwhile, the privatization of the enterprise of such type presumes that together with paying a specified sum for the acquisition, investors are obliged to admit this social burden. While modelling privatization as a change in ownership structure we assume that the final decision of the LA is made concerning the whole portion of their holdings. Following the approach described in the literature review section, we define the price paid by the investors being proportionate to the profit generated by their holdings' share.

Additionally, we propose that when the funds from privatization are obtained, these do not bear distortionary nature in contrast to revenue derived from taxation. Consequently, there arises an additional source of exploiting proceeds from privatization to redirect them for servicing transfer payments. The elimination of this loss from an increase in the financial support that stems from privatization proceeds is associated with the equivalent effects on the social welfare and the Firm's profit. Note, that we by no means imply that privatization completely replaces taxations as a financial source; however, as soon as the lower portion of transfer payments can now be financed with excess social burden, the society as a whole is likely to benefit from such state of affairs.

So, now we are in a position to examine the objective function of PPP after privatization has occurred:

$$
\begin{aligned}
U^{PRIVAT'N} &= \omega W(P) + [1-\omega]\pi = \omega[V(P) - [1+\lambda](T-\omega\pi) + \alpha\pi] + [1-\omega]\pi = \\
&\omega V(P) - \omega[1+\lambda]T + \left[\omega^2(1+\lambda) + \omega(\alpha-1) + 1\right]\pi = \\
&\omega\left[V(P) - [1+\lambda]T + \left[\omega(1+\lambda) + (\alpha-1) + \frac{1}{\omega}\right]\pi\right]
\end{aligned}
$$

We can show that there exists a non-empty set of values for ω which make new weight either positively or negatively depend on the share placed on producer surplus (see the Appendix for the proof.). This reflects the trade-off faced by the Local Authorities: on the one hand, the higher transfer needed for the Service provider has adverse effect in terms of higher pressure on the society resulting from the higher stream of cash flows needed to serve investors' interests, however, the efficiency gain is obtained due to the exploitation of proceeds from privatization used to service transfer payments. So, there must exist a benchmark weight ω after which the positive effect of reduced transfer base that is subject to distortion and lower tariff charge outweigh the negative effect caused due to higher transfer requirements.

Ultimately, we can draw the same conclusions concerning the increase in the expected welfare as compared to both PSO and PPP and ambiguous effect on the profit level (see the Appendix for the proof.)

4. DISCUSSION

The revelation of the governmental budget constraint has proven to be a decisive determinant of the choice of the institutional structure and operational decision in the game as we have put it. It should be noticed, that the importance of this factor has been recognized and given special attention as a constituent part of the policies of the European Union and European Monetary System. Most compelling evidence is provided by the Maastricht Treaty (1991), which prescribes the members that want to enter the economic and monetary union to maintain a restrictive fiscal policy, keeping a maximum ratio of government deficit to GDP of 3%, and ratio of government debt to GDP of 60%. Among other factors, this has prompted the Government to look for the opportunity for shifting off a portion of their expenditures towards the private sector. Forthwith, suburban railway sector has not become an exception and the tendency towards privatization has grown widespread.

Notwithstanding, in the context of our model the governmental budget constraint acts as an informational signal received in the second period of the game which helps to distinguish between various institutional and operating scenarios. However, it does not provide sufficient justification alone for privatization scenario especially in the context of Russian suburban railway system, which is completely different from the one established in European countries. Likewise, we are assuming that not only monetary, but also political motives have created stimuli for privatization as the best socially optimal outcome.

Table 1: The marginal cost of public funds ($MCF = 1 + \lambda$) for labour taxes in the EU and Russia (in euros)

	Labour Taxes	Energy Taxes		Labour Taxes	Energy Taxes
EU Average (GDP weighted)	1.9	1.08	**Russia Average (GDP weighted)**	2.3	1.7
Austria	1.82	0.87	Ireland	1.33	0.62
Belgium	1.98	0.63	Italy	1.68	1.10
Bulgaria	1.56	0.62	Lithuania	1.45	0.84
Czech Rep.	1.49	0.81	Latvia	1.42	0.82
Germany	1.96	1.14	Netherlands	1.57	0.83
Greece	1.59	0.85	Romania	1.43	0.89
Spain	1.79	0.89	Sweden	2.06	0.87
Finland	1.61	0.63	Slovenia	1.66	0.95
France	2.41	1.42	United Kingdom	1.81	1.13

Source: European Commission Taxation Papers, №35 - 2013

Having hitherto worked within the framework of distortionary nature of taxation, we should note that in Russia the excess burden of contractionary fiscal policy instruments is associated with relatively large marginal cost of public funds (MCF), as compared to the average value of the EU countries (see Table 1). This raises the scope for the government working in the direction of reducing this distortionary feature by changing the source of funds for future transfer distribution.

5. Conclusions

We propose that at the start of the reform service provider nurtured an idea of privatization of the established joint enterprise by creating value and selling it to private investors who would grasp the benefits of profitable business. The “value creation” process is mainly achieved through two instruments: tariff setting and the stream of transfer payments. Since private investors are not empowered to change the tariff setting reached in the period prior to privatization, the value comes from the latter stream ensuring that investors choose a project with a positive net present value (NPV). Since NPV represents a sum of discounted cash flows generated by the project, we must take into consideration those flows that may be tradable, value enhancing and are possible to evaluate and compare. Namely, an important consequence of this value maximization principle is that if having the scenario of privatization in mind the Local Authorities must apriori opt for higher portion of the ownership to be capable of selling it later and extracting proceeds. It must also be noticed that, as a matter of our modelling, the stream of transfers from the government is a constituent part of the profit. Naturally, in case of privatization positive-profit condition, $\pi > 0$, must be satisfied. Accordingly, it must be the case that investors believe that the government’s commitment to the persistent stream of transfers is credible in a sense that it does not divert from its’ decision. This is also reflected in the proposition put forward by Laffont and Tirole (1993) that “privatizing reflects the idea that privatizations are long-term decisions whose effects cover several periods”. In other words, the necessary but not sufficient conditions for privatization are positive profit and credible commitment of the government to the stream of transfer payments.

These considerations have an impact on the organizational choice made by the government. The model shows that successful privatization is associated with higher transfer requirements from the budget. The commitment of the government to sustainably support the established PPP attracts private investors, since the flow of budget transfers is inherited in the future profit.

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APPENDIX

PROOF OF A1:

The Langrangian associated with the optimization problem above can be written as:

$$L = \int \left[V - (1-\alpha)R + (\alpha - 1 - \lambda)T + \alpha(F - \theta Q) + \mu(R'Q' - \theta Q' + T'Q') \right] d\theta$$

where $R'Q' - \theta Q' + T' = 0$ is FOC of *(IC) and $T' = t$

Using Euler conditions for optimization, where I stands for the integrand $[.]$, we obtain:

$$\frac{\partial I}{\partial X} = \frac{d}{d\theta}\frac{\partial I}{\partial X'} \; for X = Q, T$$

$$\frac{\partial I}{\partial Q} = V' - (1-\alpha)R' - \alpha\theta + \mu R''Q' = \mu(R''Q' - 1 + t) + \mu'(R' - \theta)$$

$$\frac{\partial I}{\partial T} = \alpha - 1 - \lambda = \mu'$$

Due to the presence of free-boundary problem (Ibid, p. 95), we can choose $\mu(\underline{\theta}) = 0$ and obtain:

$$\mu(\theta) = (\alpha - 1 - \lambda)(\theta - \underline{\theta})$$

$$P\left[Q(\theta)\right] = \mu R''Q' - \mu + \mu'R' - \mu'\theta + (1-\alpha)R' + \alpha\theta + (\lambda + 1 - \alpha)t - \mu R''Q' =$$
$$= -\mu - \theta(\mu' - \alpha) - \lambda R'(\lambda + 1 - \alpha)t$$

$$R' = \left(\frac{aQ - Q^2}{b} \right)' = \frac{1}{b}(a - 2Q) = \frac{1}{b}(a - 2(a - bP))$$

$$P^{OPT} = \frac{(\lambda + 1 - \alpha)(\theta - \underline{\theta})}{1 + 2\lambda} + \theta\frac{1+\lambda}{1+2\lambda} + \frac{a}{b}\frac{\lambda}{1+2\lambda} =$$
$$= \frac{1}{1+2\lambda}\left[(\lambda + 1 - \alpha)(\theta - \underline{\theta}) + \theta(1+\lambda) + \frac{a}{b}\lambda \right]$$

PROFIT AND EXPECTED SOCIAL WELFARE UNDER PSO:

Once the upper bound for the budget constraint has become revealed, it further serves as a parameter that is already determined and depends on the level of cost only. Hence, for the matter of generality we would further refer to it as $T^{PSO}(\theta)$:

$$\pi = T^{PSO} - F + Q(P - \theta + t)$$

$$E\pi = T^{PSO} - F + \left[a - b\frac{1}{1+2\lambda}\left[(\lambda + 1 - \alpha)(\theta - \underline{\theta}) + \theta(1+\lambda) + \frac{a}{b}\lambda\right]\right]*$$

$$*\left[\frac{1}{1+2\lambda}\left[(\lambda + 1 - \alpha)(\theta - \underline{\theta}) + \theta(1+\lambda) + \frac{a}{b}\lambda\right] - \theta\right] =$$

$$= T^{PSO} - F + \frac{\left[a(1+2\lambda - b\lambda) - b\left((\lambda+1-\alpha)(\theta - \underline{\theta}) + \theta(1+\lambda)\right)\right]*\left[(\lambda + 1 - \alpha)(\theta - \underline{\theta}) + \lambda(\frac{a}{b} - \theta)\right]}{(1+2\lambda)^2} =$$

$$= T^{PSO} - F + \frac{b(a - b\theta)(\lambda + 1 - \alpha)(\theta - \underline{\theta}) - (\lambda + 1 - \alpha)^2(\theta - \underline{\theta})^2 + (1+\lambda)\lambda(a - b\theta)^2}{b(1+2\lambda)^2}$$

Note, that the sign of the change in profit with the change in the weight α depends on the values taken by the corresponding parameters:

$$\frac{\partial\pi}{\partial\alpha} = \frac{1}{1+2\lambda)^2}\left\{\begin{matrix} -a(1+2\lambda - b\lambda)(\theta - \underline{\theta}) + b(\theta - \underline{\theta}) - b\theta(1+\lambda) - a(1+2\lambda - b\lambda)(\theta - \underline{\theta}) - 2b(\lambda + 1 - \alpha)(\theta - \underline{\theta})^2 - \\ -b\theta(1+\lambda)(\theta - \underline{\theta}) + \lambda(a - b\theta)(\theta - \underline{\theta}) + (\lambda + 1 - \alpha)(\theta - \underline{\theta})(1+2\lambda) \end{matrix}\right\}$$

$$(\theta - \underline{\theta}) \vee \frac{b\theta(1+2\lambda + \theta - \underline{\theta})}{\lambda\{a - b\theta - 2(1+2\lambda - b\lambda)\} + b\{1 - 2(\lambda + 1 - \alpha)(\theta - \underline{\theta})\}}$$

Where the right side of the equation is higher than the left part only for values of λ being high enough:

$$(2+b)\lambda + (a - b\theta)\lambda^3 > \frac{a\alpha(\theta - \underline{\theta} + (1-\alpha)3\theta^2 - \underline{\theta})}{b(1-\alpha)(\theta - \underline{\theta})}$$

Below we obtain the expression for the resulting expected social welfare:

$$EW^{PSO} = \frac{Q^2}{2b} - (1+\lambda)T(Q) + \alpha\pi =$$

$$= \frac{(a + 2a\lambda - b\left[(\lambda + 1 - \alpha)((\theta - \underline{\theta})) + \theta(1+\lambda) + \frac{a}{b}\lambda\right])^2}{2b(1+\lambda)^2} - (1+\lambda)T^{PSO} +$$

$$+ \alpha\left[T^{PSO} - F + \frac{b(a - b\theta)(\lambda + 1 - \alpha)(\theta - \underline{\theta}) - (\lambda + 1 - \alpha)^2(\theta - \underline{\theta})^2 + (1+\lambda)\lambda(a - b\theta)^2}{b(1+2\lambda)^2}\right] =$$

$$= \frac{\left[(1+\lambda)(a - b\theta) - b(\lambda + 1 - \alpha)(\theta - \underline{\theta})\right]^2}{2b(1+\lambda)^2} - (1+\lambda - \alpha)T^{PSO} - \alpha F +$$

$$+ \alpha\frac{b(a - b\theta)(\lambda + 1 - \alpha)(\theta - \underline{\theta}) - (\lambda + 1 - \alpha)^2(\theta - \underline{\theta})^2 + (1+\lambda)\lambda(a - b\theta)^2}{b(1+2\lambda)^2} =$$

$$= \frac{2b(1+\lambda)(a - b\theta)(\lambda + 1 - \alpha)(\theta - \underline{\theta})(\alpha - 1) + (\lambda + 1 - \alpha)^2(\theta - \underline{\theta})^2(b^2 - 2\alpha) + (1+\alpha)(a - b\theta)\left[(1+\lambda)\lambda(a - b\theta) + 2\lambda\right]}{2b(1+\lambda)^2} -$$

$$-(1+\lambda - \alpha)T^{PSO} - \alpha F$$

Now examine how the change in α influences expected social welfare:

$$\frac{\partial EW^{PSO}}{\partial \alpha}=\frac{(1+\lambda)(a-b\theta)\left[2b(\theta-\underline{\theta})(\lambda+2(1-\alpha))\right]+2(\lambda+1-\alpha)(b^2-\lambda-\alpha-1)}{2b(1+\lambda)^2}-\frac{(1+\lambda-\alpha)(\theta-\underline{\theta})}{1+2\lambda}=$$
$$=\frac{(1+\lambda)(a-b\theta)\left[2b(\theta-\underline{\theta})(\lambda+2(1-\alpha))\right]-2(\lambda+1-\alpha)\left[b^2-(1+\lambda+\alpha)-b(1+2\lambda)(\theta-\underline{\theta})\right]}{2b(1+\lambda)^2}$$

Since $b^2-(1+\lambda+\alpha)-b(1+2\lambda)(\theta-\underline{\theta})<0$, as a matter of the model construction, we state that social welfare increases with the rise in α, $\frac{\partial EW^{PSO}}{\partial \alpha}>0$.

PROOF OF PROPOSITION 2:

The Langrangian associated with the optimization problem above can be written as:

$$L=\int\left[R+T-\theta Q-F+\mu(R'Q'-\theta Q')\right]d\theta$$

where $R'Q'-\theta Q'=0$ is FOC of *(IC) and the level of the transfer is now exogenously imposed. Using Euler conditions for optimization, where I stands for the integrand $[.]$, we obtain:

$$\frac{\partial I}{\partial Q}=\frac{d}{d\theta}\frac{\partial I}{\partial Q'}$$
$$\frac{\partial I}{\partial Q}=R'-\theta+\mu R''Q'=\mu(R''Q'-1)+\mu'(R'-\theta)$$

Since the constraint is not binding by the definition as we have put it, the solution would correspond to the case when $\mu=0$, so that the tariff charged $P=\frac{a}{b}$ would reduce the remaining quantity up to zero.

PROOF OF PROPOSITION 3:

Since the objective function $U_{PPP}=\omega W+(1-\omega)\pi$ is a monotonic transformation of the objective function that we dealt with earlier, except for replacing the variable ψ for the variable α, we can rewrite the solution to the optimization problem as equivalent to the one we have already obtained making a substitution of the corresponding variables:

$$P^{PPP} = \frac{(\lambda+1-\psi)(\theta-\underline{\theta})}{1+2\lambda} + \theta\frac{1+\lambda}{1+2\lambda} + \frac{a}{b}\frac{\lambda}{1+2\lambda} =$$
$$= \frac{1}{1+2\lambda}\left[(\lambda+1-\psi)(\theta-\underline{\theta}) + \theta(1+\lambda) + \frac{a}{b}\lambda\right]$$
$$Q^{PPP} = a - b\frac{1}{1+2\lambda}\left[(\lambda+1-\psi)(\theta-\underline{\theta}) + \theta(1+\lambda) + \frac{a}{b}\lambda\right]$$
$$T^{PPP}(\overline{\theta}) = F + Q^{PPP}(\theta - P^{PPP}) =$$
$$= F + \left[a - b\frac{1}{1+2\lambda}\left[(\lambda+1-\psi)(\overline{\theta}-\underline{\theta}) + \overline{\theta}(1+\lambda) + \frac{a}{b}\lambda\right]\right]*$$
$$*\left[\overline{\theta} - \frac{1}{1+2\lambda}\left[(\lambda+1-\psi)(\overline{\theta}-\underline{\theta}) + \overline{\theta}(1+\lambda) + \frac{a}{b}\lambda\right]\right]$$

PROFIT AND EXPECTED SOCIAL WELFARE UNDER PUBLIC PRIVATE PARTNERSHIP:

Note, that the expression for expected profit in this case is identical to that obtained under PSO, albeit plugging variable ψ for the variable α :

$$\pi = T^{PPP} - F + Q(P - \theta + t)$$
$$E\pi = T^{PPP} - F + \left[a - b\frac{1}{1+2\lambda}\left[(\lambda+1-\alpha)(\theta-\underline{\theta}) + \theta(1+\lambda) + \frac{a}{b}\lambda\right]\right]*$$
$$*\left[\frac{1}{1+2\lambda}\left[(\lambda+1-\alpha)(\theta-\underline{\theta}) + \theta(1+\lambda) + \frac{a}{b}\lambda\right] - \theta\right] =$$
$$= T^{PPP} - F + \frac{\left[a(1+2\lambda-b\lambda) - b\left((\lambda+1-\alpha)(\theta-\underline{\theta}) + \theta(1+\lambda)\right)\right]*\left[(\lambda+1-\alpha)(\theta-\underline{\theta}) + \lambda(\frac{a}{b}-\theta)\right]}{(1+2\lambda)^2}$$

where $T^{PPP} > T^{PSO}$ as has been outlined above. However, as we have already noted, the direction of the change in the profit level is unclear.

The same logic applies for determination of expected welfare, with the sign of the inequality being determined in the same manner when examining the expected welfare change under PSO :

$$EW^{PPP} = \frac{2b(1+\lambda)(a-b\theta)(\lambda+1-\psi)(\theta-\underline{\theta})(\psi-1) + (\lambda+1-\psi)^2(\theta-\underline{\theta})^2(b^2-2\psi) + (1+\alpha)(a-b\theta)\left[(1+\lambda)\lambda(a-b\theta)+2\lambda\right]}{2b(1+\lambda)^2} -$$
$$-(1+\lambda-\psi)T^{PSO} - \alpha F > EW^{PSO}$$

PROOF OF EXISTENCE OF $\omega \neq \emptyset, |\omega| < \infty$:

Define $\gamma = \omega(1+\lambda) + (\alpha - 1) + \frac{1}{\omega}$ representing the new weight placed on the profit. Notice, $\gamma = \psi + \omega(1+\lambda)$

$$\frac{\partial \gamma}{\partial \omega} = 1 + \lambda - \frac{1}{\omega^2} > 0 \quad \text{iff} \quad \omega \in \left(0, \sqrt{\frac{1}{1+2\lambda}}\right)$$

$$\frac{\partial \gamma}{\partial \omega} \leq 0 \quad \text{iff} \quad \omega \geq \sqrt{\frac{1}{1+2\lambda}}$$

PROFIT AND EXPECTED SOCIAL WELFARE UNDER PRIVATIZATION:

For the same reasoning as that employed in the case above describing PPP creation without privatization, we use the fact that the objective function considered earlier is a monotonic transformation of the objective function that we dealt with before. Hence, we can write the expressions for the variables of interest substituting the variable γ for the variable ψ:

$$P^{PRIVAT'N} = \frac{(\lambda + 1 - \gamma)(\theta - \underline{\theta})}{1+2\lambda} + \theta \frac{1+\lambda}{1+2\lambda} + \frac{a}{b}\frac{\lambda}{1+2\lambda} =$$

$$= \frac{1}{1+2\lambda}\left[(\lambda + 1 - \gamma)(\theta - \underline{\theta}) + \theta(1+\lambda) + \frac{a}{b}\lambda\right]$$

$$Q^{PRIVAT'N} = a - b\frac{1}{1+2\lambda}\left[(\lambda + 1 - \gamma)(\theta - \underline{\theta}) + \theta(1+\lambda) + \frac{a}{b}\lambda\right]$$

$$T^{PRIVAT'N}(\overline{\theta}) = F + Q^{PRIVAT'N}(\theta - P^{PRIVAT'N}) =$$

$$= F + \left[a - b\frac{1}{1+2\lambda}\left[(\lambda + 1 - \gamma)(\overline{\theta} - \underline{\theta}) + \overline{\theta}(1+\lambda) + \frac{a}{b}\lambda\right]\right]*$$

$$*\left[\overline{\theta} - \frac{1}{1+2\lambda}\left[(\lambda + 1 - \gamma)(\overline{\theta} - \underline{\theta}) + \overline{\theta}(1+\lambda) + \frac{a}{b}\lambda\right]\right]$$

Alternatively, the expression for profit is:

$$\pi = T^{PRIVAT'N} - F + Q(P - \theta)$$

$$E\pi = T^{PRIVAT'N} - F + \left[a - b\frac{1}{1+2\lambda}\left[(\lambda + 1 - \gamma)(\overline{\theta} - \underline{\theta}) + \overline{\theta}(1+\lambda) + \frac{a}{b}\lambda\right]\right]*$$

$$*\left[\frac{1}{1+2\lambda}\left[(\lambda + 1 - \gamma)(\overline{\theta} - \underline{\theta}) + \overline{\theta}(1+\lambda) + \frac{a}{b}\lambda\right] - \overline{\theta}\right] =$$

$$= T^{PRIVAT'N} - F + \frac{\left[a(1+2\lambda - b\lambda) - b\left((\lambda + 1 - \gamma)(\overline{\theta} - \underline{\theta}) + \theta(1+\gamma)\right)\right]*\left[(\lambda + 1 - \gamma)(\overline{\theta} - \underline{\theta}) + \lambda\left(\frac{a}{b} - \overline{\theta}\right)\right]}{(1+2\lambda)^2}$$

The same conclusions as of the increase in the expected welfare can be made as compared to both PSO and PPP:

$$EW^{RIVAT'N} = \frac{2b(1+\lambda)(a - b\theta)(\lambda + 1 - \gamma)(\theta - \underline{\theta})(\gamma - 1) + (\lambda + 1 - \gamma)^2(\theta - \underline{\theta})^2(b^2 - 2\gamma) + (1+\alpha)(a - b\theta)\left[(1+\lambda)\lambda(a - b\theta) + 2\lambda\right]}{2b(1+\lambda)^2} -$$

$$-(1 + \lambda - \psi)T^{PSO} - \alpha F > EW^{PPP} > EW^{PSO}$$